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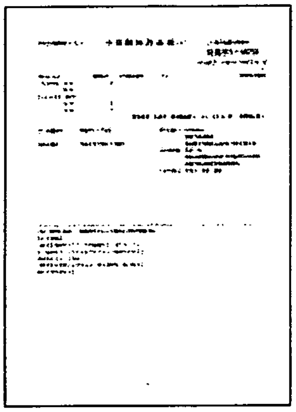

Title: FIBER-REINFORCED CEMENT PRODUCT AND ITS PRODUCTION

Abstract: PURPOSE: To produce a fiber-reinforced cement product excellent in strength and design properties of the surface by conducting dehydration molding of an aqueous slurry containing a solid matter having a specified composition and curing and hardening the resultant intermediate molding.

CONSTITUTION: This is a method for producing a fiber-reinforced cement product by conducting dehydration-molding of a hydraulic slurry into a prescribed shape to prepare an intermediate molding and curing and hardening the resultant intermediate molding. In this production method, the solid matter composition of the used hydraulic slurry is as follows; cement and/or lime: 5 to 70 wt.%; slag: 0 to 50wt.%; gypsum: 0 to 50wt.%; powdery silica stone: 20 to 60wt.%; perlite: 0 to 30wt.%; magnesium hydroxide: 0 to 20wt.%; silica fume: 0 to 20wt.%; cellulose fiber: 2 to 30wt.%; organic admixture except cellulose fiber: 0 to 20wt.%. The average fiber length of the cellulose fiber is 1.5 to 3.0mm and the fiber length is 0.1mm to 6mm.

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(57) [Abstract]
[Structure] A fiber-reinforced cement product that contains a reinforcing material of cellulose fibers with the fiber length being 0.1 to 6mm and the mean fiber length being 1.5 to 3.0mm
[Effects] With the current invention, products will provide excellent effects in the surface design characteristics and bending strength.

[Scope of patent claiming (What is claimed is:)]
[Claim 1] A fiber-reinforced cement product containing cellulose fibers having a fiber length of 0.1 to 6mm and a mean fiber length of 1.5 to 3.0mm as a reinforcing material
[Claim 2] A method of manufacturing a fiber-reinforced cement product through the processes of dehydrating and molding hydraulic slurry into the prescribed shape, molding the intermediate molded object and then curing and hardening the intermediate molded object, and it is also a method of manufacturing a fiber-reinforced cement product in which blended are the solid contents of hydraulic

slurry include cement and/or lime of 5 to 70 weight %, slag of 0 to 50 weight %, gypsum of 0 to 50 weight %, silica stone powder of 20 to 60 weight %, perlite of 0 to 30 weight %, magnesium hydroxide of 0 to 20 weight %, silica fume of 0 to 20 weight %, inorganic aggregate, which is different from the above items, of 0 to 20 weight %, cellulose fiber of 2 to 30 weight %, and organic admixture, which is different from cellulose fiber, of 0 to 2 weight %, where the cellulose fibers have a fiber length 0.1 to 6mm and a mean fiber length of 1.5 to 3.0mm.
[Claim 3] A method of manufacturing a fiber-reinforced cement product that is described in Claim 2, in which the said silica stone powder has an area/weight ratio of 6,000 to 9,000cm^2/g

[Detailed description of the invention]
[0001]
[Field of utilization in the industry] The current invention relates to the fiber-reinforced cement products and the method of manufacture.
[0002]
[Background technology] It has conventionally been suggested to add cellulose fibers into fiber-reinforced cement products for the purpose of enhancing the strength and the processibility of the products, in PatPub No. H1-22502, for example.
[0003] With such a method, however, the strength of products was not always sufficient, and the surface design characteristics was not satisfactory either because the contained fibrillated and beaten cellulose fibers had a wide range of length, from too long to too short.
[0004]
[Problem that the invention will solve] The current invention is intended to solve the previously mentioned problem involved in the conventional technology and to provide fiber-reinforced cement products that are excellent in the strength of products and the surface design characteristics, and the method of manufacture.
[0005]
[Means of solving problems] The current invention provides a fiber-reinforced cement product containing cellulose fibers having a mean fiber length of 1.5 to 3.0mm and a fiber length of 0.1 to 6mm as the reinforcing material.
[0006] In the current invention, the term of "fiber length" refers to the value measured with a microscope, and the term of "mean fiber length" refers to the weighted mean of the fiber length measured over approximately 200 fibers, calculated according to the JIS Z8103.
[0007] With the current invention, cellulose fibers contained in fiber-reinforced cement products as the reinforcing material have a mean fiber length ranging from 1.5 to 3.0mm, and a fiber length ranging from 0.1 to 6mm.
[0008] If the mean fiber length is less than 1.5mm or if the fiber length is less than 0.1mm, the reinforcing effect will be insufficient, failing to provide the intended strength. On the contrary, if the mean fiber length is longer than 3.0mm, or if the fiber length is longer than 6mm, it will not be easy for cellulose fiber to be uniformly dispersed, decreasing the strength of the parts in which the content of cellulose fibers is low, and deteriorating the surface design characteristics.
[0009] Cellulose fibers to be used should have a diameter of 1□ m to 0.1mm or so, as it is usual. Such cellulose fibers should be obtained through the process of pulp fibrillating and beating, as they are made in the normal method.
[0010] The content of the cellulose fibers should preferably in the range from 2 to 30 weight %. If the content of cellulose fibers is less than 2 weight %, the strength will be too low, which is not desirable, and if it is over 30 weight %, it will be hard to secure uniform dispersion, decreasing the strength of the parts in which the content of cellulose fibers is low, which is not desirable either.
[0011] For the matrix, used are well known materials, such as a single cement material, and a mixed material in which gypsum, slag, lime and silica stone powder are blended in the cement.
Besides this cellulose fiber and the matrix, it is also possible to add perlite and other elements in order to improve different characteristics.
[0012] Such fiber-reinforced cement products can be manufactured in the following way: First,
mix raw materials in the proportion of cement and/or lime of 5 to 70 weight %, slag of 0 to 50 weight %, gypsum of 0 to 50 weight %, silica stone powder of 20 to 60 weight %, perlite of 0 to 30 weight %, magnesium hydroxide of 0 to 20 weight %, silica fume of 0 to 20 weight %, inorganic aggregate, which is different from the above items, of 0 to 20 weight %, cellulose fiber 2 to 30 weight %, and organic admixture, which is different from cellulose fiber, of 0 to 2 weight %.
[0013] Among the above items, cement and lime exert the following action: $Ca(OH)_2$ and SiO_2 generated in the hydration reaction of the cement cause a hydrothermal reaction, producing CaO-SiO_2-H_2O based

and/or tobermorite or other hydrate. Such $CaO-SiO_2-H_2O$ based and tobermorite are excellent in the durability and bending strength. If the content of cement and lime is less than 5% in total, a large quantity of unreacted SiO_2 will be left, reducing the bending strength. If the content of cement and lime is higher than 70% in total, a large quantity of unreacted $Ca(OH)_2$ will be left, which makes the material more prone to carbonation by CO_2 gas, decrease the durability. The content of cement and lime should be in the abovementioned range, and more preferably be in the range from 40 to 60% in total.
[0014] For such cement, examples should include portland cement, alumina cement, sulfate-resisting cement, blast furnace cement, and pozzolan cement. Among the above, portland cement and alumina cement have a property of high early strength, which is desirable because it is not very likely to generate intermediate products such as ettringite and its monosulfate hydrate, and it is easy to produce tobermorite.

[0015] Although it is not an essential component, slag is advantageous as follows if it is contained: the reaction of Al_2O_3 in slag facilitates generation of tobermorite, which enhances bending strength as well as freeze resistance and dissolubility. If the content of slag exceeds 50%, however, it accelerates generation of H_2S and other elements in the autoclave for curing. Desirable content of slag should be 30 to 50%.
[0016] Although it is not an essential component, gypsum has an advantage of giving higher plasticity to the materials if it is contained, reducing the risk of chipping and other damage. If the content of gypsum exceeds 50%, however, it will allow intermediate products to emerge, such as ettringite and its monosulfate hydrate, hindering the production of tobermorite, which is the final product. Desirable content of gypsum should be 2 to 10%.
[0017] Silica stone powder exerts the following action: to make a hydrothermal reaction with $Ca(OH)_2$ to produce $CaO-SiO_2-H_2O$ based and/or tobermorite. For silica stone powder, desirable is silica stone fine powder, which is high in crystallinity, because it facilitates production of $CaO-SiO_2-H_2O$ based and/or tobermorite.
[0018] If the content of silica stone powder is less than 20%, this will accelerate aged deterioration by carbonation, and if it exceeds 60%, it will decrease the strength.
[0019] For silica stone fine powder, the area/weight ratio should preferably be in the range from 3,500 to 10,000cm^2/g. If it is less than 3,500cm^2/g, the SiO_2 reaction rate will be left under 50%, reducing the bending strength. If it exceeds 10,000cm^2/g, it will become hard to uniformly mix the slurry, and even if a sufficient degree of mixing is attained, separation will occur from other raw materials when in molding, failing to achieve uniform quality. More desirable area/weight ratio of silica stone fine powder should be in the range from 6,000 to 9,000cm^2/g. The measurement of the area/weight ratio of such silica stone fine powder should conform to the Blaine method in JIS R5201.
[0020] Although it is not an essential component, perlite can contribute to lighter weight of products if it is contained. If the content of perlite exceeds 30%, however, it will be necessary to add a large quantity of water when in mixing, lowering the productivity.
[0021] Although it is not an essential component, magnesium hydroxide will improve the stability of hydrate if it is contained, enhancing the durability in the long view. If the content of magnesium hydroxide exceeds 20%, however, it will remain unreacted after completion of curing, reducing the bending strength.
[0022] Although it is not an essential component, silica fume promotes generation of hydrate if it is contained, with its high reactivity. Furthermore, it is of an ultrafine particle of mean particle size being 0.1 to 1□m, and therefore, it can be filled between cellulose fibers and other gaps, enhancing the freeze resistance and the dissolubility as well as the surface design characteristics. If the content of silica fume exceeds 20%, however, the dehydration ability will lower.
[0023] Although it is not an essential component, inorganic aggregate, which is different from the abovementioned items, (hereafter, simply referred to as inorganic aggregate) has the following advantages if it is contained. Calcium carbonate and mica, for example, enhance the dimensional stability, without disturbing the reactivity of cement and other items. If the content of inorganic aggregate exceeds 20%, however, the bending strength will be reduced.
[0024] If the content of cellulose fibers is less than 2%, the strength of products will be lowered, and if it exceeds 30%, the fibers will not be easily dispersed uniformly in the raw material. For cellulose fibers, the mean fiber length should be 1.5 to 3.0mm and the fiber length should be 0.1 to 6mm for the reasons that slurry fluidity is high, permitting more uniform dispersion. For the fiber diameter, 1□m to 0.1mm should be desirable.

[0025] For the method of manufacturing cellulose fibers, preferably apply wet fibrillation or beating after cutting sheet-shaped cellulose fibers into flakes or, apply wet fibrillation or beating while using a double-disc refiner because the fiber length will be more uniform.
[0026] Although it is not an essential component, organic admixture, which are different from cellulose fibers, (hereafter, simply referred to as organic admixture) has the following advantages if it is contained. Polyvinyl alcohol powder and/or styrene powder, for example, is dissolved at 50 to 150°C, and it fills gaps in the hydrate when in curing, enhancing the freeze resistance and dissolubility. If the content of organic admixture exceeds 2%, however, the characteristics of incombustibility will become lower.
[0027] Those raw materials are mixed with water to make slurry, which will be used at the percentage of solid contents is in the range from 10 to 30 weight % or so. This slurry is molded into the prescribed shape using a sheet making method, dehydration press method, form casting method and other methods in order to produce intermediate molded object. Then, this intermediate object is cured in order to manufacture fiber-reinforced cement products. For a desirable curing method, the material undergoes wet curing under the saturated vapor pressure at 60 to 80°C, and further, it receives autoclave curing at high temperature and high pressure of 150 to 180°C to secure better productivity and strength.
[0028]
[Action] With the current invention, more homogeneous fiber-reinforced cement products can be produced with excellent quality in the strength and/or surface design characteristics compared with the case of using conventional cellulose fibers due to enhanced fluidity and moldability of the slurry.
[0029]
[Preferred embodiment] For preparation in advance, a pulp sheet(s) undergoes dry cutting into flakes of length 20mm and width 2mm, and with water added, the flakes receive refiner fibrillating and beating, and then they go through pulper fibrillating and beating, or otherwise,
after the pulp sheet(s) undergoing flake processing, with water added to them, and receive fibrillating and beating by pulper, in order to create cellulose fibers of Case 1, Case 2, and Case 3. Next, raw materials are prepared so that the following proportions are ensured: cement 30 weight %, silica stone fine powder 40 weight %, perlite 10 weight %, cellulose fiber 10 weight %, magnesium hydroxide 5 weight %, calcium carbonate 5 weight %, and water was added to produce slurry.

[0030] The values of slurry viscosity are shown in Table 1. The values of area/weight ratio of the silica stone fine powder that was used, measured according to JIS R5201, are also shown in Table 1. Approximately 200 cellulose fibers were measured by their length by microscope and the longest value among them was set to the maximum fiber length, and the shortest value was set to the minimum fiber length. The mean fiber length was calculated from the values of fiber length of approximately 200 fibers measured according to JIS Z8103, and the values are also shown in Table 1.
[0031] Next, the slurry was pressurized for dehydration to produce a piece of intermediate molded object of 16mm thickness. Then, the intermediate molded object was cured under the saturated steam pressure at 80°C for 8 hours, followed by an autoclave process at 160°C for 15 hours for curing, thus creating samples.
[0032] For Case 4, which was a comparative case, samples were created in the same manner as in Case 3 except the use of sheet-shaped cellulose fibers fibrillated and beaten by pulper, instead of using dry cutting.
[0033] Those samples were measured by their bulk specific gravity, bending strength and surface design characteristics, and the results are shown in Table 1. Bulk specific gravity was measured as per JIS A5413, "Test of bulk specific gravity of asbestos cement perlite board", and bending strength was measured as per JIS A5422. Evaluation of surface design characteristics of samples was made by five judges using five-level rating (to give 5 points to the most excellent one in surface design characteristics and give 1 point to the worst one to evaluate the surface design characteristics at five grades), and the average rating is indicated by the symbol of "×" for 2 points and lower, by the symbol of "□" for 3 and 4 and by the symbol of "@" for 4 points and higher.
[0034] With the current invention, it is possible to prepare slurry of high fluidity and high moldability as obvious from Table 1. Furthermore it is possible to manufacture products having the quality superior in strength and surface design characteristics.
[0035]
[Table 1]

	Case 1	Case 2	Case 3	Case 4
Area/weight ratio of silica	7000	7000	3500	3500

stone fine powder (cm^2/g)				
	Fibrillating and beating by refiner □ Fibrillating and beating by pulper	Flake processing □ Fibrillating and beating by pulper	Flake processing □ Fibrillating and beating by pulper	Fibrillating and beating by pulper
Mean fiber length (mm)	2.6	2.2	2.2	3.9
Maximum fiber length (mm)	5.9	2.8	2.8	7.9
Minimum fiber length (mm)	0.5	0.5	0.5	0.5
Viscosity (cSt)	1,350	1,200	1,200	1,600
Bulk specific gravity	0.988	0.985	0.991	0.987
Bending strength (kg/cm^2)	105	115	85	60
Surface design characteristics	□	@	@	×

[0036]
[Effects of invention] With the current invention, products will have excellent effects in the surface design characteristics and the bending strength.

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[Name or designation] IZUMINA-Kenji

(57) [Abstract]
[Structure] A fiber-reinforced cement product that contains a reinforcing material of cellulose fibers with the fiber length being 0.1 to 6mm and the mean fiber length being 1.5 to 3.0mm
[Effects] With the current invention, products will provide excellent effects in the surface design characteristics and bending strength.

[Scope of patent claiming (What is claimed is:)]
[Claim 1] A fiber-reinforced cement product containing cellulose fibers having a fiber length of 0.1 to 6mm and a mean fiber length of 1.5 to 3.0mm as a reinforcing material
[Claim 2] A method of manufacturing a fiber-reinforced cement product through the processes of dehydrating and molding hydraulic slurry into the prescribed shape, molding the intermediate molded object and then curing and hardening the intermediate molded object, and it is also a method of manufacturing a fiber-reinforced cement product in which blended are the solid contents of hydraulic

slurry include cement and/or lime of 5 to 70 weight %, slag of 0 to 50 weight %, gypsum of 0 to 50 weight %, silica stone powder of 20 to 60 weight %, perlite of 0 to 30 weight %, magnesium hydroxide of 0 to 20 weight %, silica fume of 0 to 20 weight %, inorganic aggregate, which is different from the above items, of 0 to 20 weight %, cellulose fiber of 2 to 30 weight %, and organic admixture, which is different from cellulose fiber, of 0 to 2 weight %, where the cellulose fibers have a fiber length 0.1 to 6mm and a mean fiber length of 1.5 to 3.0mm.
[Claim 3] A method of manufacturing a fiber-reinforced cement product that is described in Claim 2, in which the said silica stone powder has an area/weight ratio of 6,000 to 9,000cm^2/g

[Detailed description of the invention]
[0001]
[Field of utilization in the industry] The current invention relates to the fiber-reinforced cement products and the method of manufacture.
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[Background technology] It has conventionally been suggested to add cellulose fibers into fiber-reinforced cement products for the purpose of enhancing the strength and the processibility of the products, in PatPub No. H1-22502, for example.
[0003] With such a method, however, the strength of products was not always sufficient, and the surface design characteristics was not satisfactory either because the contained fibrillated and beaten cellulose fibers had a wide range of length, from too long to too short.
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[Problem that the invention will solve] The current invention is intended to solve the previously mentioned problem involved in the conventional technology and to provide fiber-reinforced cement products that are excellent in the strength of products and the surface design characteristics, and the method of manufacture.
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[Means of solving problems] The current invention provides a fiber-reinforced cement product containing cellulose fibers having a mean fiber length of 1.5 to 3.0mm and a fiber length of 0.1 to 6mm as the reinforcing material.
[0006] In the current invention, the term of "fiber length" refers to the value measured with a microscope, and the term of "mean fiber length" refers to the weighted mean of the fiber length measured over approximately 200 fibers, calculated according to the JIS Z8103.
[0007] With the current invention, cellulose fibers contained in fiber-reinforced cement products as the reinforcing material have a mean fiber length ranging from 1.5 to 3.0mm, and a fiber length ranging from 0.1 to 6mm.
[0008] If the mean fiber length is less than 1.5mm or if the fiber length is less than 0.1mm, the reinforcing effect will be insufficient, failing to provide the intended strength. On the contrary, if the mean fiber length is longer than 3.0mm, or if the fiber length is longer than 6mm, it will not be easy for cellulose fiber to be uniformly dispersed, decreasing the strength of the parts in which the content of cellulose fibers is low, and deteriorating the surface design characteristics.
[0009] Cellulose fibers to be used should have a diameter of 1□m to 0.1mm or so, as it is usual. Such cellulose fibers should be obtained through the process of pulp fibrillating and beating, as they are made in the normal method.
[0010] The content of the cellulose fibers should preferably in the range from 2 to 30 weight %. If the content of cellulose fibers is less than 2 weight %, the strength will be too low, which is not desirable, and if it is over 30 weight %, it will be hard to secure uniform dispersion, decreasing the strength of the parts in which the content of cellulose fibers is low, which is not desirable either.
[0011] For the matrix, used are well known materials, such as a single cement material, and a mixed material in which gypsum, slag, lime and silica stone powder are blended in the cement.
Besides this cellulose fiber and the matrix, it is also possible to add perlite and other elements in order to improve different characteristics.
[0012] Such fiber-reinforced cement products can be manufactured in the following way: First,
mix raw materials in the proportion of cement and/or lime of 5 to 70 weight %, slag of 0 to 50 weight %, gypsum of 0 to 50 weight %, silica stone powder of 20 to 60 weight %, perlite of 0 to 30 weight %, magnesium hydroxide of 0 to 20 weight %, silica fume of 0 to 20 weight %, inorganic aggregate, which is different from the above items, of 0 to 20 weight %, cellulose fiber 2 to 30 weight %, and organic admixture, which is different from cellulose fiber, of 0 to 2 weight %.
[0013] Among the above items, cement and lime exert the following action: $Ca(OH)_2$ and SiO_2 generated in the hydration reaction of the cement cause a hydrothermal reaction, producing CaO-SiO_2-H_2O based

and/or tobermorite or other hydrate. Such $CaO-SiO_2-H_2O$ based and tobermorite are excellent in the durability and bending strength. If the content of cement and lime is less than 5% in total, a large quantity of unreacted SiO_2 will be left, reducing the bending strength. If the content of cement and lime is higher than 70% in total, a large quantity of unreacted $Ca(OH)_2$ will be left, which makes the material more prone to carbonation by CO_2 gas, decrease the durability. The content of cement and lime should be in the abovementioned range, and more preferably be in the range from 40 to 60% in total.

[0014] For such cement, examples should include portland cement, alumina cement, sulfate-resisting cement, blast furnace cement, and pozzolan cement. Among the above, portland cement and alumina cement have a property of high early strength, which is desirable because it is not very likely to generate intermediate products such as ettringite and its monosulfate hydrate, and it is easy to produce tobermorite.

[p3/5]

[0015] Although it is not an essential component, slag is advantageous as follows if it is contained: the reaction of Al_2O_3 in slag facilitates generation of tobermorite, which enhances bending strength as well as freeze resistance and dissolubility. If the content of slag exceeds 50%, however, it accelerates generation of H_2S and other elements in the autoclave for curing. Desirable content of slag should be 30 to 50%.

[0016] Although it is not an essential component, gypsum has an advantage of giving higher plasticity to the materials if it is contained, reducing the risk of chipping and other damage. If the content of gypsum exceeds 50%, however, it will allow intermediate products to emerge, such as ettringite and its monosulfate hydrate, hindering the production of tobermorite, which is the final product. Desirable content of gypsum should be 2 to 10%.

[0017] Silica stone powder exerts the following action: to make a hydrothermal reaction with $Ca(OH)_2$ to produce $CaO-SiO_2-H_2O$ based and/or tobermorite. For silica stone powder, desirable is silica stone fine powder, which is high in crystallinity, because it facilitates production of $CaO-SiO_2-H_2O$ based and/or tobermorite.

[0018] If the content of silica stone powder is less than 20%, this will accelerate aged deterioration by carbonation, and if it exceeds 60%, it will decrease the strength.

[0019] For silica stone fine powder, the area/weight ratio should preferably be in the range from 3,500 to $10{,}000cm^2/g$. If it is less than $3{,}500cm^2/g$, the SiO_2 reaction rate will be left under 50%, reducing the bending strength. If it exceeds $10{,}000cm^2/g$, it will become hard to uniformly mix the slurry, and even if a sufficient degree of mixing is attained, separation will occur from other raw materials when in molding, failing to achieve uniform quality. More desirable area/weight ratio of silica stone fine powder should be in the range from 6,000 to $9{,}000cm^2/g$. The measurement of the area/weight ratio of such silica stone fine powder should conform to the Blaine method in JIS R5201.

[0020] Although it is not an essential component, perlite can contribute to lighter weight of products if it is contained. If the content of perlite exceeds 30%, however, it will be necessary to add a large quantity of water when in mixing, lowering the productivity.

[0021] Although it is not an essential component, magnesium hydroxide will improve the stability of hydrate if it is contained, enhancing the durability in the long view. If the content of magnesium hydroxide exceeds 20%, however, it will remain unreacted after completion of curing, reducing the bending strength.

[0022] Although it is not an essential component, silica fume promotes generation of hydrate if it is contained, with its high reactivity. Furthermore, it is of an ultrafine particle of mean particle size being 0.1 to 1□m, and therefore, it can be filled between cellulose fibers and other gaps, enhancing the freeze resistance and the dissolubility as well as the surface design characteristics. If the content of silica fume exceeds 20%, however, the dehydration ability will lower.

[0023] Although it is not an essential component, inorganic aggregate, which is different from the abovementioned items, (hereafter, simply referred to as inorganic aggregate) has the following advantages if it is contained. Calcium carbonate and mica, for example, enhance the dimensional stability, without disturbing the reactivity of cement and other items. If the content of inorganic aggregate exceeds 20%, however, the bending strength will be reduced.

[0024] If the content of cellulose fibers is less than 2%, the strength of products will be lowered, and if it exceeds 30%, the fibers will not be easily dispersed uniformly in the raw material. For cellulose fibers, the mean fiber length should be 1.5 to 3.0mm and the fiber length should be 0.1 to 6mm for the reasons that slurry fluidity is high, permitting more uniform dispersion. For the fiber diameter, 1□m to 0.1mm should be desirable.

[0025] For the method of manufacturing cellulose fibers, preferably apply wet fibrillation or beating after cutting sheet-shaped cellulose fibers into flakes or, apply wet fibrillation or beating while using a double-disc refiner because the fiber length will be more uniform.
[0026] Although it is not an essential component, organic admixture, which are different from cellulose fibers, (hereafter, simply referred to as organic admixture) has the following advantages if it is contained. Polyvinyl alcohol powder and/or styrene powder, for example, is dissolved at 50 to 150°C, and it fills gaps in the hydrate when in curing, enhancing the freeze resistance and dissolubility. If the content of organic admixture exceeds 2%, however, the characteristics of incombustibility will become lower.
[0027] Those raw materials are mixed with water to make slurry, which will be used at the percentage of solid contents is in the range from 10 to 30 weight % or so. This slurry is molded into the prescribed shape using a sheet making method, dehydration press method, form casting method and other methods in order to produce intermediate molded object. Then, this intermediate object is cured in order to manufacture fiber-reinforced cement products. For a desirable curing method, the material undergoes wet curing under the saturated vapor pressure at 60 to 80°C, and further, it receives autoclave curing at high temperature and high pressure of 150 to 180°C to secure better productivity and strength.
[0028]
[Action] With the current invention, more homogeneous fiber-reinforced cement products can be produced with excellent quality in the strength and/or surface design characteristics compared with the case of using conventional cellulose fibers due to enhanced fluidity and moldability of the slurry.
[0029]
[Preferred embodiment] For preparation in advance, a pulp sheet(s) undergoes dry cutting into flakes of length 20mm and width 2mm, and with water added, the flakes receive refiner fibrillating and beating, and then they go through pulper fibrillating and beating, or otherwise,
after the pulp sheet(s) undergoing flake processing, with water added to them, and receive fibrillating and beating by pulper, in order to create cellulose fibers of Case 1, Case 2, and Case 3. Next, raw materials are prepared so that the following proportions are ensured: cement 30 weight %, silica stone fine powder 40 weight %, perlite 10 weight %, cellulose fiber 10 weight %, magnesium hydroxide 5 weight %, calcium carbonate 5 weight %, and water was added to produce slurry.

[0030] The values of slurry viscosity are shown in Table 1. The values of area/weight ratio of the silica stone fine powder that was used, measured according to JIS R5201, are also shown in Table 1. Approximately 200 cellulose fibers were measured by their length by microscope and the longest value among them was set to the maximum fiber length, and the shortest value was set to the minimum fiber length. The mean fiber length was calculated from the values of fiber length of approximately 200 fibers measured according to JIS Z8103, and the values are also shown in Table 1.
[0031] Next, the slurry was pressurized for dehydration to produce a piece of intermediate molded object of 16mm thickness. Then, the intermediate molded object was cured under the saturated steam pressure at 80°C for 8 hours, followed by an autoclave process at 160°C for 15 hours for curing, thus creating samples.
[0032] For Case 4, which was a comparative case, samples were created in the same manner as in Case 3 except the use of sheet-shaped cellulose fibers fibrillated and beaten by pulper, instead of using dry cutting.
[0033] Those samples were measured by their bulk specific gravity, bending strength and surface design characteristics, and the results are shown in Table 1. Bulk specific gravity was measured as per JIS A5413, "Test of bulk specific gravity of asbestos cement perlite board", and bending strength was measured as per JIS A5422. Evaluation of surface design characteristics of samples was made by five judges using five-level rating (to give 5 points to the most excellent one in surface design characteristics and give 1 point to the worst one to evaluate the surface design characteristics at five grades), and the average rating is indicated by the symbol of "×" for 2 points and lower, by the symbol of "□" for 3 and 4 and by the symbol of "@" for 4 points and higher.
[0034] With the current invention, it is possible to prepare slurry of high fluidity and high moldability as obvious from Table 1. Furthermore it is possible to manufacture products having the quality superior in strength and surface design characteristics.
[0035]
[Table 1]

	Case 1	Case 2	Case 3	Case 4
Area/weight ratio of silica	7000	7000	3500	3500

stone fine powder (cm^2/g)				
	Fibrillating and beating by refiner □ Fibrillating and beating by pulper	Flake processing □ Fibrillating and beating by pulper	Flake processing □ Fibrillating and beating by pulper	Fibrillating and beating by pulper
Mean fiber length (mm)	2.6	2.2	2.2	3.9
Maximum fiber length (mm)	5.9	2.8	2.8	7.9
Minimum fiber length (mm)	0.5	0.5	0.5	0.5
Viscosity (cSt)	1,350	1,200	1,200	1,600
Bulk specific gravity	0.988	0.985	0.991	0.987
Bending strength (kg/cm^2)	105	115	85	60
Surface design characteristics	□	@	@	×

[0036]
[Effects of invention] With the current invention, products will have excellent effects in the surface design characteristics and the bending strength.

JP8040758A FIBER-REINFORCED CEMENT PRODUCT AND ITS PRODUCTION

Assignee:	*ASAHI GLASS CO LTD*
Publication Date:	1996-02-13
Inventors:	*YADA AKIRA*
Application Number:	JP1994177221A
Application Date:	1994-07-28

PURPOSE: To produce a fiber-reinforced cement product excellent in strength and design properties of the surface by conducting dehydration molding of an aqueous slurry containing a solid matter having a specified composition and curing and hardening the resultant intermediate molding.

CONSTITUTION: This is a method for producing a fiber-reinforced cement product by conducting dehydration-molding of a hydraulic slurry into a prescribed shape to prepare an intermediate molding and curing and hardening the resultant intermediate molding. In this production method, the solid matter composition of the used hydraulic slurry is as follows; cement and/or lime: 5 to 70 wt.%; slag: 0 to 50wt.%; gypsum: 0 to 50wt.%; powdery silica stone: 20 to 60wt.%; perlite: 0 to 30wt.%; magnesium hydroxide: 0 to 20wt.%; silica fume: 0 to 20wt.%; cellulose fiber: 2 to 30wt.%; organic admixture except cellulose fiber: 0 to 20wt.%. The average fiber length of the cellulose fiber is 1.5 to 3.0mm and the fiber length is 0.1mm to 6mm.